Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

KARST SINKHOLE TREATMENT

Code 527

(No.)

DEFINITION

The treatment of sinkholes in karst areas to reduce contamination of groundwater resources, and to improve farm safety.

PURPOSE

The practice supports one or more of the following purposes:

- Improve ground and surface water quality
- Conserve soil and surface water resources
- Improve farm safety

CONDITIONS WHERE PRACTICE APPLIES

This practice may be applied as part of a conservation management system in karst topography which is an area underlain by carbonate or sulfate bedrock (e.g., limestone, dolomite, gypsum) which may form solution depressions (e.g., sinkholes), caverns, or solution subsidence (e.g., areas of non-soluble rocks that may collapse into underlying solution cavities).

This practice does not apply to erosional or collapse features caused by failure or leakage of underground pipes or constructed surface drainage features (e.g., canals), piping of unstable soil materials, or poorly compacted or constructed features.

This practice does not apply to karst sinkholes that may appear in or beneath structures or in flowing streams. Treatment of sinkholes in these areas are outside the scope of this standard.

CRITERIA

General Criteria Applicable to All Purposes

The installation and operation of karst sinkhole treatment(s) shall comply with all applicable Federal, State, and local laws, rules, and regulations.

Conduct a geologic investigation of the potential impact of the treatment on groundwater, surface water influent, and the karst features under the supervision of a qualified geologist as defined in the NRCS National Engineering Manual, Part 531, Geology. The geologic investigation may include information obtained from local experts, such as other Federal agencies, State agencies, and academic institutions. If conditions are complex and uncertain, use additional expertise to conduct onsite evaluation and to provide professional recommendations regarding the suitability of the site for treatment.

Develop nutrient and pest management plans for the portion of the drainage area surrounding the sinkhole feature which is controlled by the landowner. However, the preparation of these plans shall not result in a delay of treatment of an immediate safety concern.

Remove refuse and all other unsuitable material from the sinkhole and the established buffer area and dispose of it in an environmentally sound manner.

Vegetative Treatment. The minimum treatment of a sinkhole must include a fenced vegetated buffer (e.g., filter strips, field borders, riparian forest buffers) that meets the intent of the selected NRCS conservation practice standard(s). The buffer will serve as a means to exclude people, animals, and equipment. The buffer will also serve to increase the overland flow path for surface water leading to the karst topography in an effort to minimize the potential for direct contamination into the sinkhole.

The buffer will be a minimum of 25-feet wide as measured from the farthest estimated point of collapse. (Note: This may represent an interior portion of the feature, rather than measured from the surface rim of the sinkhole). Extend the buffer area as needed to prevent concentrated flow channels from occurring and entering the sinkhole. The width of the vegetated buffer will be established and maintained in accordance with the type of buffer chosen.

Use appropriate erosion and sediment control measures to reduce the amount of sediment entering sinkhole openings during the establishment of the vegetative buffer. Do not apply nutrients, herbicides, pesticides, and animal waste within the established buffer area. Use only mechanical treatments for weed control.

Surface Water Control. Changes to the volume of surface water that enters a sinkhole may disturb the underground hydrology. To the extent possible, the surface water flow should be maintained at historic (or predevelopment) volumes. Minimal alterations should be made while stabilizing pre-existing concentrated flow channels. Disperse concentrated flow caused by construction activities with suitable spreading or diversion techniques.

Sinkhole Treatment/Closing. Adequate protection of most sinkhole and sinkhole areas can be achieved by the use of vegetative buffers and livestock exclusion. However, if an open sinkhole presents a safety hazard, it may be treated with an inverted filter, geosynthetics, gabions, or other appropriate methods. To enable a suitable design when a sinkhole will be closed by an inverted filter or plug, the area of concern will be characterized by a qualified geologist in consultation with the engineer.

Excavate the sinkhole area to competent, stable bedrock, if possible. All rock, aggregates, and soil used to treat the sinkhole shall be filter-compatible in the direction of flow, per the NRCS National Engineering Handbook, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters.

A sinkhole that opens into a cave shall not be filled under any circumstances. A cave is defined as a naturally formed subterranean open area or chamber or series of chambers that is a direct conduit into rock devoid of sediment infilling. Gated openings may be used for safety reasons. Design gates so that they do not impede movement or negatively impact wildlife species such as bats.

Karst areas may provide habitat for a diversity of highly specialized and sensitive fish and wildlife species such as bats, amphibians, fish, insects, and crustaceans including federally listed threatened or endangered species. NRCS shall follow all policies associated with the Endangered Species Act.

CONSIDERATIONS

Current and planned land use should be considered. Document the location of the sinkhole on a plan map so that structures, septic drain fields, wells, feedlots, ponds, animal waste storage, and other systems will not be located over a sinkhole site or within the impact area. Establishing a conservation easement for the buffer and sinkhole area should be considered.

For a sinkhole receiving contaminated overland flow, every effort should be made to first treat the source of the contamination. Although it is important to maintain the hydrology of the karst system, it may be more beneficial to the groundwater quality to divert contaminated water away from the sinkhole. In some cases, it may be necessary to completely plug a sinkhole with sealing materials rather than treat it with an inverted filter. Acceptable sealing materials are provided in ASTM D 5299, part 6.4. (An example of this would be a sinkhole in a feedlot or a site that is difficult to protect by any other method.)

The sinkhole treatment should not result in excessive surface water ponding or high soil-moisture conditions over an extended period of time.

When filling a sinkhole, mounding of the fill materials may be required to compensate for future settlement potential due to consolidation or migration of the fill material into subsurface voids. Additional fill may be required as treatment ages.

The treatment of one sinkhole may have an impact on other sinkholes or solutional features within the vicinity as hydraulic equilibrium is reestablished.

PLANS AND SPECIFICATIONS

Provide plans and specifications that describe the requirements for applying the practice to achieve its intended purpose.

Plans and specifications shall include, but not limited to—

- Plan view delineating the sinkhole and sinkhole area, including topographic information and photographs.
- A geologic investigation that includes a study of potential impacts on the karst resource.
- Depth to stable, competent bedrock, if applicable.
- Details of planned treatment measures.
- The drainage area of sinkhole delineated on a topographic map.
- Availability of safe outlet for surface water, if applicable.
- Special safety requirements, as appropriate.
- Additional site-specific considerations.

OPERATION AND MAINTENANCE

Provide an operation and maintenance (O&M) plan that describes specific instructions for maintaining the sinkhole and sinkhole area treatment, including—

- Reference to monitoring and periodic inspections.
- Nutrient and pest management.
- Prompt repair and/or replacement of damaged components.

REFERENCES

ASTM Standard D 5299. Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities. ASTM International, West Conshohocken, PA. – Latest Edition.

National Engineering Manual, Part 531 Geology, [M_210_NEH_531] – Latest Edition.

National Engineering Handbook, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters [H_210_633] – Latest Edition.